

Table II-3.1 (g)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: QPSK digital, 24 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 148
 Amplifier outout backoff: 8 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	18	148	148	148	148	144	148	148	112	32	8
10	6	148	144	48	20	8	148	28	4	0	0
25	18	148	148	148	148	148	148	148	148	80	24
25	6	148	148	124	48	20	148	76	16	4	0
50	18	148	148	148	148	148	148	148	148	148	52
50	6	148	148	148	100	44	148	148	32	9	0
100	18	148	148	148	148	148	148	148	148	148	104
100	6	148	148	148	148	92	148	148	68	20	4
250	18	148	148	148	148	148	148	148	148	148	148
250	6	148	148	148	148	148	148	148	148	48	16
500	18	148	148	148	148	148	148	148	148	148	148
500	6	148	148	148	148	148	148	148	148	100	32
750	18	148	148	148	148	148	148	148	148	148	148
750	6	148	148	148	148	148	148	148	148	148	48
1000	18	148	148	148	148	148	148	148	148	148	148
1000	6	148	148	148	148	148	148	148	148	148	68

Table II-3.2 (a)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: FM, 36 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 25
 Amplifier output backoff: 8 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	14	25	25	25	25	19	25	25	15	4	1
10	10	25	25	25	16	7	25	25	6	1	0
25	14	25	25	25	25	25	25	25	25	10	3
25	10	25	25	25	25	19	25	25	15	4	1
50	14	25	25	25	25	25	25	25	25	21	7
50	10	25	25	25	25	25	25	25	25	8	2
100	14	25	25	25	25	25	25	25	25	25	14
100	10	25	25	25	25	25	25	25	25	17	5
250	14	25	25	25	25	25	25	25	25	25	25
250	10	25	25	25	25	25	25	25	25	25	14
500	14	25	25	25	25	25	25	25	25	25	25
500	10	25	25	25	25	25	25	25	25	25	25
750	14	25	25	25	25	25	25	25	25	25	25
750	10	25	25	25	25	25	25	25	25	25	25
1000	14	25	25	25	25	25	25	25	25	25	25
1000	10	25	25	25	25	25	25	25	25	25	25

Table II-3.2 (b)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: FM, 24 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 37
 Amplifier output backoff: 8 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		-----					-----				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	14	37	37	37	37	29	37	37	22	6	2
10	10	37	37	37	25	11	37	37	8	2	0
25	14	37	37	37	37	37	37	37	37	16	5
25	10	37	37	37	37	29	37	37	22	6	2
50	14	37	37	37	37	37	37	37	37	32	10
50	10	37	37	37	37	37	37	37	37	12	4
100	14	37	37	37	37	37	37	37	37	37	21
100	10	37	37	37	37	37	37	37	37	25	8
250	14	37	37	37	37	37	37	37	37	37	37
250	10	37	37	37	37	37	37	37	37	37	21
500	14	37	37	37	37	37	37	37	37	37	37
500	10	37	37	37	37	37	37	37	37	37	37
750	14	37	37	37	37	37	37	37	37	37	37
750	10	37	37	37	37	37	37	37	37	37	37
1000	14	37	37	37	37	37	37	37	37	37	37
1000	10	37	37	37	37	37	37	37	37	37	37

Table II-3.2 (c)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: FM, 18 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 50
 Amplifier output backoff: 8 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	14	50	50	50	27	12	50	42	9	2	0
10	10	50	50	26	10	4	50	16	3	1	0
25	14	50	50	50	50	31	50	50	23	6	2
25	10	50	50	50	26	12	50	42	9	2	0
50	14	50	50	50	50	50	50	50	47	13	4
50	10	50	50	50	50	24	50	50	19	5	1
100	14	50	50	50	50	50	50	50	50	27	9
100	10	50	50	50	50	49	50	50	38	10	3
250	14	50	50	50	50	50	50	50	50	50	22
250	10	50	50	50	50	50	50	50	50	27	9
500	14	50	50	50	50	50	50	50	50	50	45
500	10	50	50	50	50	50	50	50	50	50	18
750	14	50	50	50	50	50	50	50	50	50	50
750	10	50	50	50	50	50	50	50	50	50	27
1000	14	50	50	50	50	50	50	50	50	50	50
1000	10	50	50	50	50	50	50	50	50	50	36

Table II-3.2(d)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: AM, 6 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 166
 Amplifier output backoff: 20 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		-----					-----				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	14	0	0	0	0	0	0	0	0	0	0
10	10	0	0	0	0	0	0	0	0	0	0
25	14	0	0	0	0	0	0	0	0	0	0
25	10	0	0	0	0	0	0	0	0	0	0
50	14	0	0	0	0	0	0	0	0	0	0
50	10	0	0	0	0	0	0	0	0	0	0
100	14	1	0	0	0	0	0	0	0	0	0
100	10	0	0	0	0	0	0	0	0	0	0
250	14	4	1	0	0	0	1	0	0	0	0
250	10	1	0	0	0	0	0	0	0	0	0
500	14	9	2	0	0	0	3	0	0	0	0
500	10	3	0	0	0	0	1	0	0	0	0
750	14	13	3	1	0	0	4	0	0	0	0
750	10	5	1	0	0	0	1	0	0	0	0
1000	14	18	4	1	0	0	6	1	0	0	0
1000	10	7	1	0	0	0	2	0	0	0	0

Table II-3.2 (e)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: Digital HDTV, 6 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 166
 Amplifier output backoff: 13 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	14	14	3	1	0	0	4	0	0	0	0
10	10	5	1	0	0	0	1	0	0	0	0
25	14	37	9	3	1	0	12	1	0	0	0
25	10	14	3	1	0	0	4	0	0	0	0
50	14	74	18	6	2	1	24	3	0	0	0
50	10	29	7	2	1	0	9	1	0	0	0
100	14	148	37	12	5	2	49	7	1	0	0
100	10	59	14	4	2	0	19	3	0	0	0
250	14	166	92	31	12	5	124	19	4	1	0
250	10	147	36	12	5	2	49	7	1	0	0
500	14	166	166	62	25	11	166	39	9	2	0
500	10	166	73	24	10	4	99	15	3	1	0
750	14	166	166	94	38	17	166	59	13	3	1
750	10	166	110	37	15	7	148	23	5	1	0
1000	14	166	166	125	50	23	166	79	18	5	1
1000	10	166	147	49	20	9	166	31	7	2	0

Table II-3.2 (f)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

Modulation method: 64 QAM-digital cable, 6 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 664
 Amplifier output backoff: 13 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		-----					-----				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
10	14	56	12	4	0	0	16	0	0	0	0
10	10	20	4	0	0	0	4	0	0	0	0
25	14	148	36	12	4	0	48	4	0	0	0
25	10	56	12	4	0	0	16	0	0	0	0
50	14	296	72	24	8	4	96	12	0	0	0
50	10	116	28	8	4	0	36	4	0	0	0
100	14	592	148	48	20	8	196	28	4	0	0
100	10	236	56	16	8	0	76	12	0	0	0
250	14	664	368	124	48	20	496	76	16	4	0
250	10	588	144	48	20	8	196	28	4	0	0
500	14	664	664	248	100	44	664	156	36	8	0
500	10	664	292	96	40	16	396	60	12	4	0
750	14	664	664	376	152	68	664	236	52	12	4
750	10	664	440	148	60	28	592	92	20	4	0
1000	14	664	664	500	200	92	664	316	72	20	4
1000	10	664	588	196	80	36	664	124	28	8	0

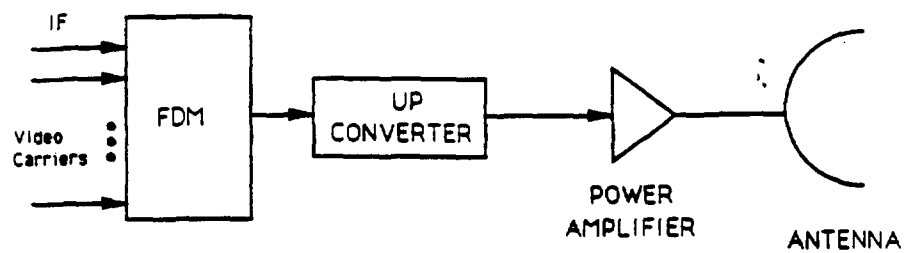
Table II-3.2(g)

NUMBER OF CHANNELS THAT CAN BE TRANSMITTED

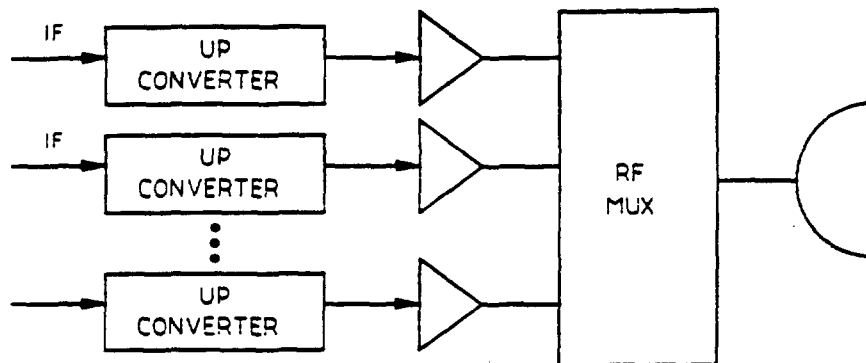
Modulation method: QPSK digital, 24 MHz bandwidth
 Maximum number of video channels that can be carried in 1 GHz: 148
 Amplifier output backoff: 8 dB
 Amplifier power rating corresponds to single carrier saturation.
 Rain Availability: 99.9 %

Video channel capacity for specified distance (mi)

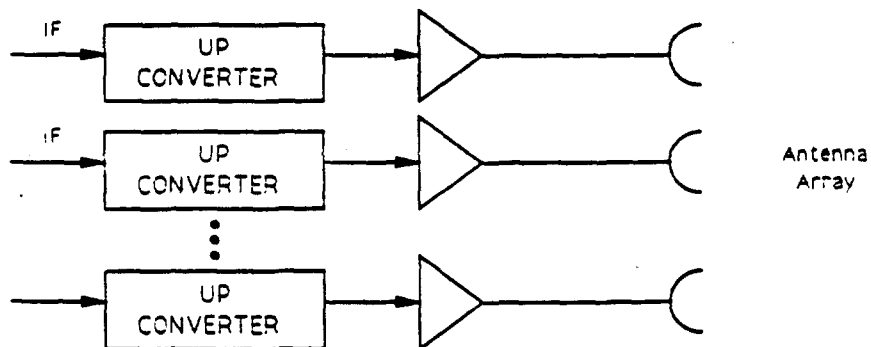
Amplifier power rating, W	Antenna gain, dB	Los Angeles					New York				
		-----					-----				
		2mi	3mi	4mi	5mi	6mi	2mi	3mi	4mi	5mi	6mi
25	14	148	148	148	148	144	148	148	112	32	8
25	10	148	148	148	124	56	148	148	44	12	4
50	14	148	148	148	148	148	148	148	148	64	20
50	10	148	148	148	148	116	148	148	88	24	8
100	14	148	148	148	148	148	148	148	148	128	40
100	10	148	148	148	148	148	148	148	148	48	16
250	14	148	148	148	148	148	148	148	148	148	104
250	10	148	148	148	148	148	148	148	148	128	40
500	14	148	148	148	148	148	148	148	148	148	148
500	10	148	148	148	148	148	148	148	148	148	84
750	14	148	148	148	148	148	148	148	148	148	148
750	10	148	148	148	148	148	148	148	148	148	128
1000	14	148	148	148	148	148	148	148	148	148	148
1000	10	148	148	148	148	148	148	148	148	148	148



OPTION A



OPTION B



OPTION C

Figure II-3.1 Transmitting System Options

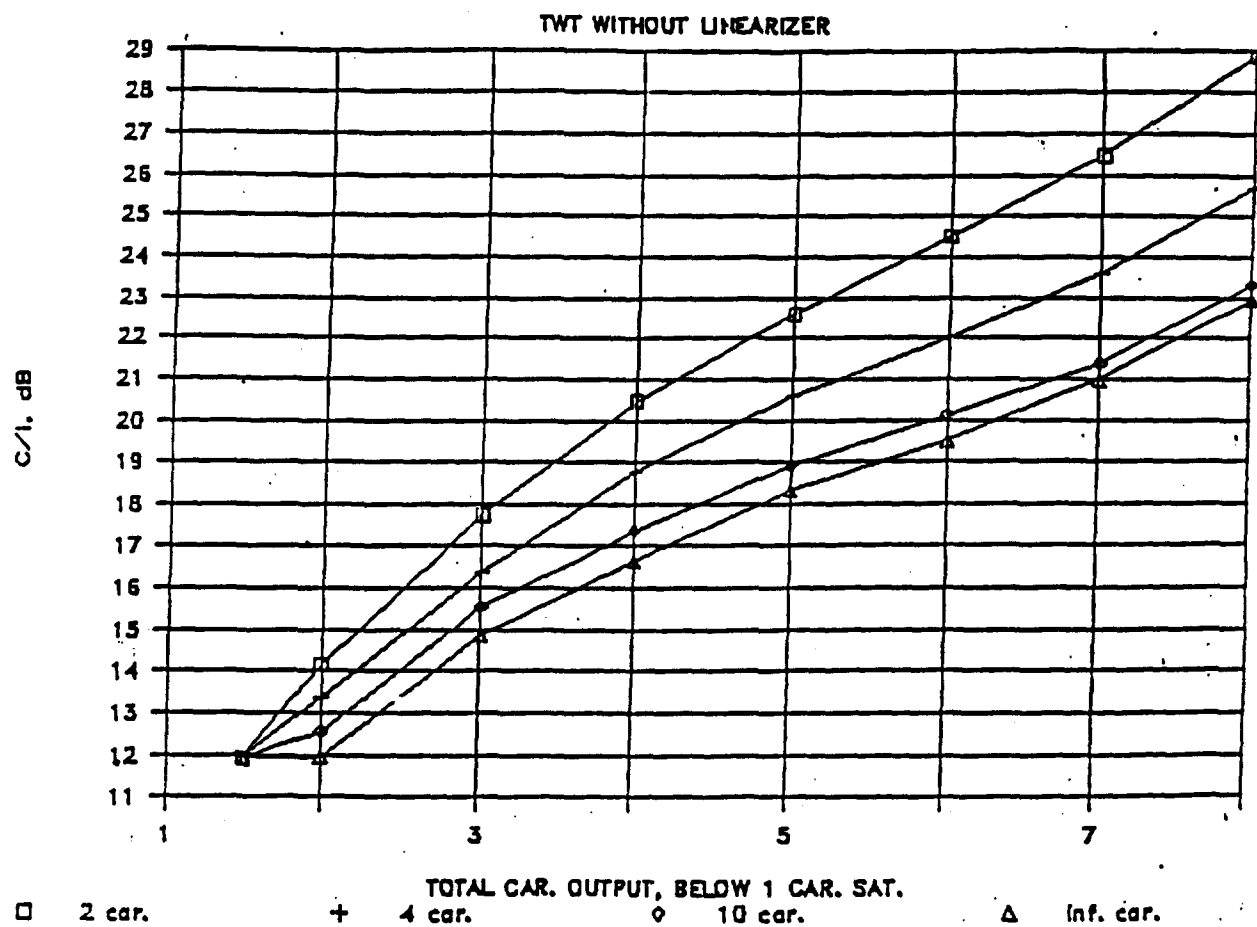


Figure II-3.2 Multiple carrier intermodulation.

4. FM Repeaters

Solid-state low cost repeaters will be used to provide coverage to shadow areas (Fig II-4.1). The signal polarization in the links between the repeater and subscribers will be polarized opposite to those in the links between headend and repeaters. Tables II-4.1 to II-4.5 give some examples of video signal power requirement at a repeater for distribution within the repeater coverage area. These tables represent a worst case calculation because they assume the repeater is positioned at the extreme edge of the transmitter's coverage area. Repeaters closer to the transmitter can have coverage areas of up to 2 miles with the same power level requirements. The repeater-to-subscriber power is adjusted to provide the appropriate coverage. In addition, proper shaping of the transmitting antenna for a given location will greatly enhance the range or coverage area. It is seen that the amplifier power requirement for 50 channels is low. For instance, at New York a repeater which can deliver 6 dBm power per FM carrier can provide a coverage of 0.75 miles, when placed at the edge of a transmitter's coverage area, and 2 miles of coverage when placed halfway to the edge. The repeater involves frequency translations (RF to IF, IF to RF) and signal amplification. Frequency control of the oscillators can be done using pilots.

Passive repeaters using reflectors can be used to propagate the signal down the sides of a building or to reach nearby shadow areas without polarization reversal. Higher gain passive repeaters can be used with a dual antenna system and may require polarization reversal.

Table II-4.1

Suite 12 Video Distribution System Link Analysis for Repeaters

City: New York

	Repeater-to-subscriber path	
	length	(miles)
	0.25	0.75
1. Repeater RF amplifier power ¹⁾ per FM channel, dBm	-3.0	6.0
2. Transmitting antenna feed loss, dB	1.0	1.0
3. Transmitting antenna gain ²⁾ , dBi	18.0	18.0
4. Free space loss (at 28 GHz), dB	113.5	123.0
5. Receiver dish antenna diameter, inches	7.5	7.5
6. Receiver antenna gain, dBi	32.0	32.0
7. Boltzmann's constant, dBW/K/Hz	-228.6	-228.6
8. Bandwidth (18 MHz), dB-Hz	72.6	72.6
9. Receiver noise temperature, dBK	29.5	29.5
10. Repeater-to-subscriber link CNR ¹⁾ , dB	29.0	28.5
11. Rain rate for 0.01% mm/hr	52.4	52.
12. Rain attenuation (99.9% availability), dB	1.5	4.3
13. Rain faded CNR ³⁾ , dB	27.5	24.2
14. Headend-to-repeater distance, miles	3.9	3.9
15. Headend-to-repeater link CNR ³⁾ in clear weather, dB	36.2	36.2
16. Headend-to-repeater link faded CNR ³⁾ , dB	17.6	17.6
17. Rain faded CNR, from headend to subscriber ⁴⁾ , dB	16.4	16.0
18. Video Receiver Transfer Function, dB	29.0	29.0
19. Clear weather Video SNR, dB	51.6	51.5
20. Rain faded SNR, dB	45.4	45.0

¹⁾ Solid state power amplifiers with single carrier saturating power values of 0.2 W and 1 W, operating at 5 to 6 dB output backoff assumed for -3 and 6 dBm cases, respectively.

²⁾ Covers a sector of 45°

³⁾ Excluding intermodulation noise. Repeater receive antenna gain is 42.0 dBi (24 inch dish).

⁴⁾ Includes intermodulation noise produced by the transmitter and repeater amplifiers. The C/IM is taken to be 24.0 dB

Table II-4.2**Suite 12 Video Distribution System Link Analysis for Repeaters****City: Boston**

	Repeater-to-subscriber path	
	length 0.25	(miles) 0.75
1. Repeater RF amplifier power ¹⁾ per FM channel, dBm	-3.0	6.0
2. Transmitting antenna feed loss, dB	1.0	1.0
3. Transmitting antenna gain ²⁾ , dBi	18.0	18.0
4. Free space loss (at 28 GHz), dB	113.5	123.0
5. Receiver dish antenna diameter, inches	7.5	7.5
6. Receiver antenna gain, dBi	32.0	32.0
7. Boltzmann's constant, dBW/K/Hz	-228.6	-228.6
8. Bandwidth (18 MHz), dB-Hz	72.6	72.6
9. Receiver noise temperature, dBK	29.5	29.5
10. Repeater-to-subscriber link CNR ¹⁾ , dB	29.0	28.5
11. Rain rate for 0.01% mm/hr	49.0	49.0
12. Rain attenuation (99.9% availability), dB	1.4	3.9
13. Rain faded CNR ³⁾ , dB	27.6	24.6
14. Headend-to-repeater distance, miles	4.1	4.1
15. Headend-to-repeater link CNR ³⁾ in clear weather, dB	35.7	35.7
16. Headend-to-repeater link faded CNR ³⁾ , dB	17.7	17.7
17. Rain faded CNR, from headend to subscriber ⁴⁾ , dB	16.4	16.1
18. Video Receiver Transfer Function, dB	29.0	29.0
19. Clear weather Video SNR, dB	51.6	51.5
20. Rain faded SNR, dB	45.4	45.1

1) Solid state power amplifiers with single carrier saturating power values of 0.2 W and 1 W, operating at 5 to 6 dB output backoff assumed for -3 and 6 dBm cases, respectively.

2) Covers a sector of 45°

3) Excluding intermodulation noise. Repeater receive antenna gain is 42.0 dBi (24 inch dish).

4) Includes intermodulation noise produced by the transmitter and repeater amplifiers. The C/IM is taken to be 24.0 dB

Table II-4.3**Suite 12 Video Distribution System Link Analysis for Repeaters****City: Chicago**

	Repeater-to-subscriber path	
	length	(miles)
	0.25	0.75
1. Repeater RF amplifier power ¹⁾ per FM channel, dBm	-3.0	6.0
2. Transmitting antenna feed loss, dB	1.0	1.0
3. Transmitting antenna gain ²⁾ , dBi	18.0	18.0
4. Free space loss (at 28 GHz), dB	113.5	123.0
5. Receiver dish antenna diameter, inches	7.5	7.5
6. Receiver antenna gain, dBi	32.0	32.0
7. Boltzmann's constant, dBW/K/Hz	-228.6	-228.6
8. Bandwidth (18 MHz), dB-Hz	72.6	72.6
9. Receiver noise temperature, dBK	29.5	29.5
10. Repeater-to-subscriber link CNR ¹⁾ , dB	29.0	28.5
11. Rain rate for 0.01% mm/hr	52.0	52.0
12. Rain attenuation (99.9% availability), dB	1.5	4.3
13. Rain faded CNR ³⁾ , dB	27.5	24.2
14. Headend-to-repeater distance, miles	3.9	3.9
15. Headend-to-repeater link CNR ³⁾ in clear weather, dB	36.2	36.2
16. Headend-to-repeater link faded CNR ³⁾ , dB	17.8	17.8
17. Rain faded CNR, from headend to subscriber ⁴⁾ , dB	16.5	16.1
18. Video Receiver Transfer Function, dB	29.0	29.0
19. Clear weather Video SNR, dB	51.3	51.2
20. Rain faded SNR, dB	45.5	45.1

1) Solid state power amplifiers with single carrier saturating power values of 0.2 W and 1 W, operating at 5 to 6 dB output backoff assumed for -3 and 6 dBm cases, respectively.

2) Covers a sector of 45°

3) Excluding intermodulation noise. Repeater receive antenna gain is 42.0 dBi (24 inch dish).

4) Includes intermodulation noise produced by the transmitter and repeater amplifiers. The C/IM is taken to be 24.0 dB

Table II-4.4

Suite 12 Video Distribution System Link Analysis for Repeaters
City: Los Angeles

	Repeater-to-subscriber path	
	length 0.25	(miles) 0.75
1. Repeater RF amplifier power ¹⁾ per FM channel, dBm	-3.0	6.0
2. Transmitting antenna feed loss, dB	1.0	1.0
3. Transmitting antenna gain ²⁾ , dBi	18.0	18.0
4. Free space loss (at 28 GHz), dB	113.5	123.0
5. Receiver dish antenna diameter, inches	7.5	7.5
6. Receiver antenna gain, dBi	32.0	32.0
7. Boltzmann's constant, dBW/K/Hz	-228.6	-228.6
8. Bandwidth (18 MHz), dB-Hz	72.6	72.6
9. Receiver noise temperature, dBK	29.5	29.5
10. Repeater-to-subscriber link CNR ¹⁾ , dB	29.0	28.5
11. Rain rate for 0.01% mm/hr	30.0	30.0
12. Rain attenuation (99.9% availability), dB	0.8	2.4
13. Rain faded CNR ³⁾ , dB	28.2	26.1
14. Headend-to-repeater distance, miles	6.0	6.0
15. Headend-to-repeater link CNR ³⁾ in clear weather, dB	32.4	32.4
16. Headend-to-repeater link faded CNR ³⁾ , dB	17.1	17.1
17. Rain faded CNR, from headend to subscriber ⁴⁾ , dB	16.0	15.8
18. Video Receiver Transfer Function, dB	29.0	29.0
19. Clear weather Video SNR, dB	51.3	51.2
20. Rain faded SNR, dB	45.0	44.8

¹⁾ Solid state power amplifiers with single carrier saturating power values of 0.2 W and 1 W, operating at 5 to 6 dB output backoff assumed for -3 and 6 dBm cases, respectively.

²⁾ Covers a sector of 45°

³⁾ Excluding intermodulation noise. Repeater receive antenna gain is 42.0 dBi (24 inch dish).

⁴⁾ Includes intermodulation noise produced by the transmitter and repeater amplifiers. The C/IM is taken to be 24.0 dB

Table II-4.5

Suite 12 Video Distribution System Link Analysis for Repeaters

City: San Francisco

	Repeater-to-subscriber path	
	length	(miles)
	0.25	0.75
1. Repeater RF amplifier power ¹⁾ per FM channel, dBm	-3.0	6.0
2. Transmitting antenna feed loss, dB	1.0	1.0
3. Transmitting antenna gain ²⁾ , dBi	18.0	18.0
4. Free space loss (at 28 GHz), dB	113.5	123.0
5. Receiver dish antenna diameter, inches	7.5	7.5
6. Receiver antenna gain, dBi	32.0	32.0
7. Boltzmann's constant, dBW/K/Hz	-228.6	-228.6
8. Bandwidth (18 MHz), dB-Hz	72.6	72.6
9. Receiver noise temperature, dBK	29.5	29.5
10. Repeater-to-subscriber link CNR ¹⁾ , dB	29.0	28.5
11. Rain rate for 0.01% mm/hr	30.0	30.0
12. Rain attenuation (99.9% availability), dB	0.8	2.4
13. Rain faded CNR ³⁾ , dB	28.2	26.1
14. Headend-to-repeater distance, miles	6.0	6.0
15. Headend-to-repeater link CNR ³⁾ in clear weather, dB	32.4	32.4
16. Headend-to-repeater link faded CNR ³⁾ , dB	17.1	17.1
17. Rain faded CNR, from headend to subscriber ⁴⁾ , dB	16.0	15.8
18. Video Receiver Transfer Function, dB	29.0	29.0
19. Clear weather Video SNR, dB	51.3	51.2
20. Rain faded SNR, dB	45.0	44.8

1) Solid state power amplifiers with single carrier saturating power values of 0.2 W and 1 W, operating at 5 to 6 dB output backoff assumed for -3 and 6 dBm cases, respectively.

2) Covers a sector of 45°

3) Excluding intermodulation noise. Repeater receive antenna gain is 42.0 dBi (24 inch dish).

4) Includes intermodulation noise produced by the transmitter and repeater amplifiers. The C/IM is taken to be 24.0 dB

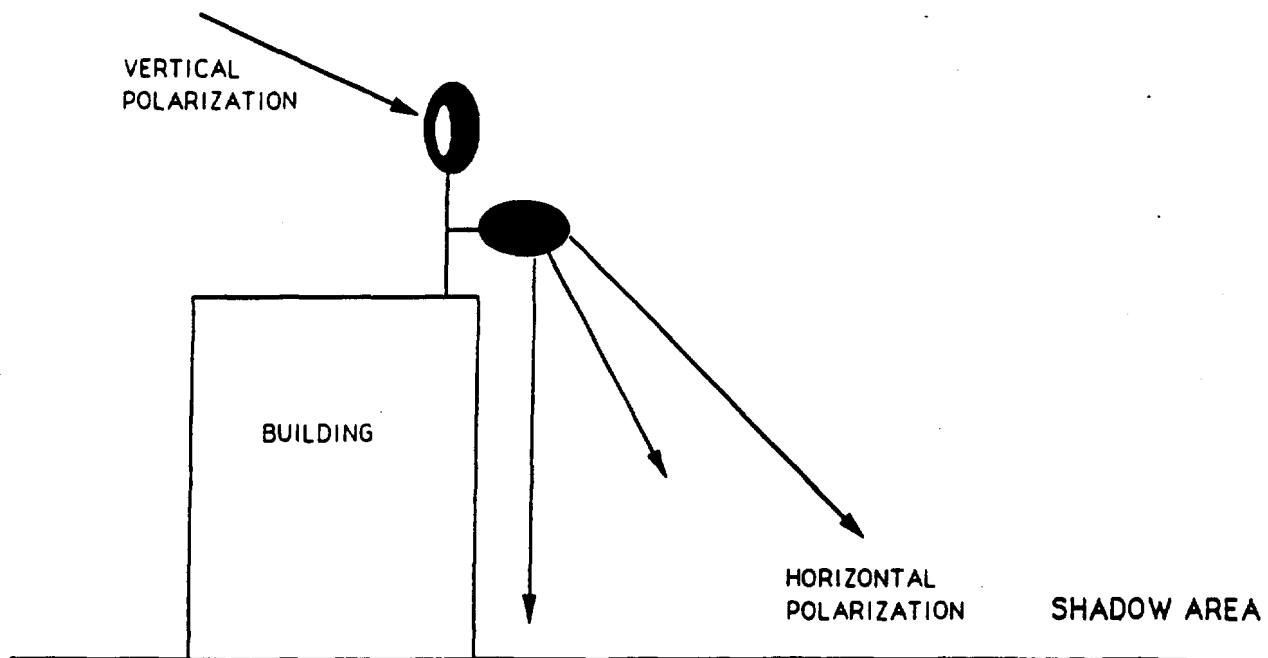


Figure II-4.1 Signal transmission for shadow areas.

5. FM Receiver

The receiver unit consists of a microwave frequency converter which converts the RF signal in 27 to 29 GHz range to an IF, typically, in the range of 950 to 2000 MHz. The details of the microwave converter will not be described here. The indoor unit converts the IF to the TV baseband, or a VSB AM signal at channel 3. The IF signal processor can be implemented in a variety of ways, and is essentially a DBS satellite receiver. Figures II-5.1 to II-5.5 show the principles, which are taken from a Philips' reference (Electronic Components and Applications, Vol. 9, No. 3). The system shown has IF in the range of 950 to 1750 MHz, which is standard for European satellite receivers. For the present application the principal difference is in the number of channels, their center frequencies (set by a micro or a PROM), and the IF SAW filter bandwidth. Many of the European DBS receivers are equipped with SAW filters that can be selected to 27 or 18 MHz bandwidth, which agree with the 27 and 20 MHz cases considered in earlier sections.

At least one European manufacturer has intimated to us that hardware for IF in 950 to 2050 MHz can be made available to Hye Crest. Clearly, this will let Hye Crest permit the full usage of the 1 GHz band.

The cost of the IF processor is essentially independent of the number of channels. Units at a price of \$200 per unit, in quantities of 5,000, have been quoted. If a mark-up of 20 to 40% by the manufacturer is removed, the real cost of chips and manufacturing would be in the range of \$120 to \$160. This does not include costs of descrambling and conditional access and pay-per-view features.

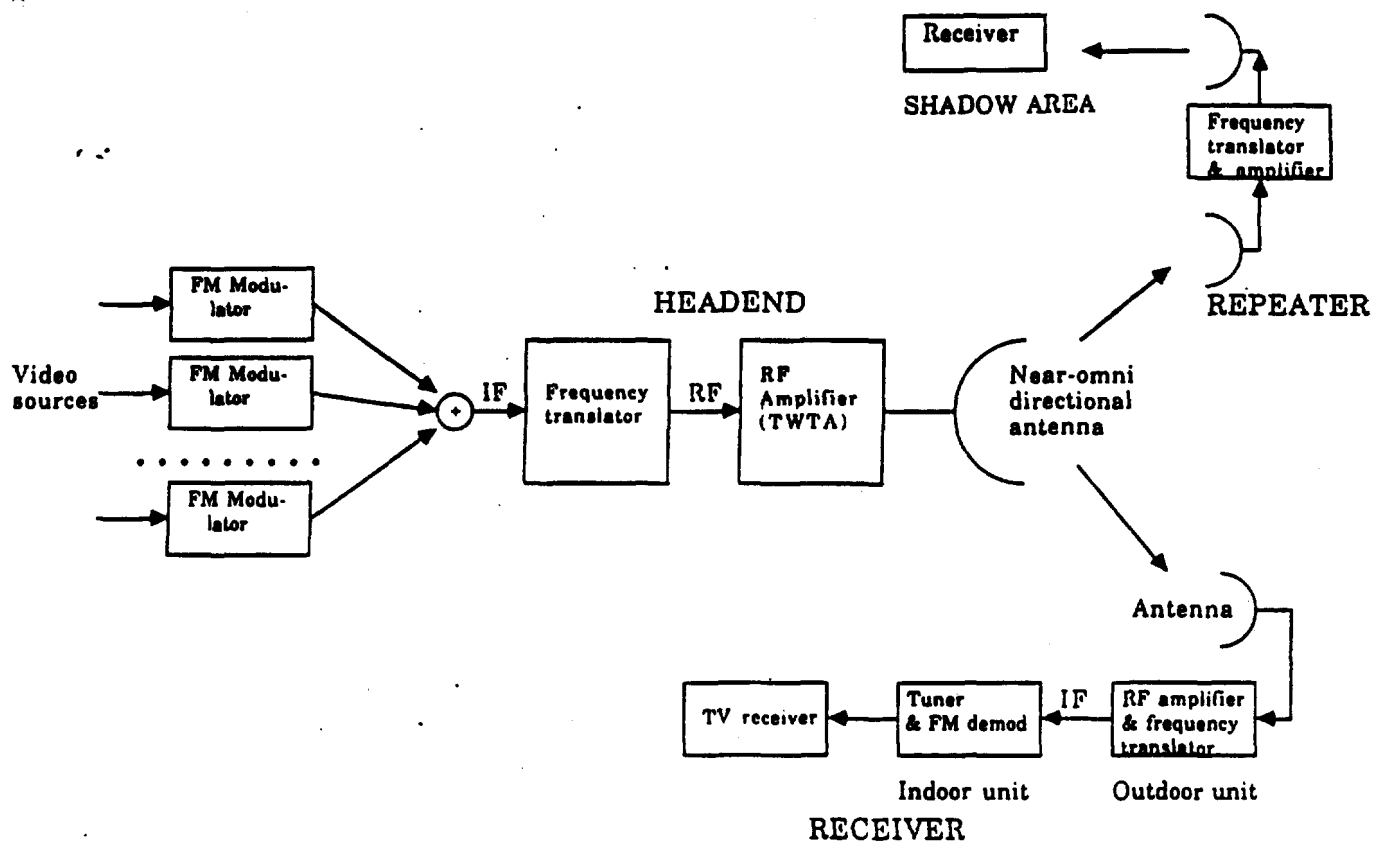


Figure II-5.1 CellularVision system principles.

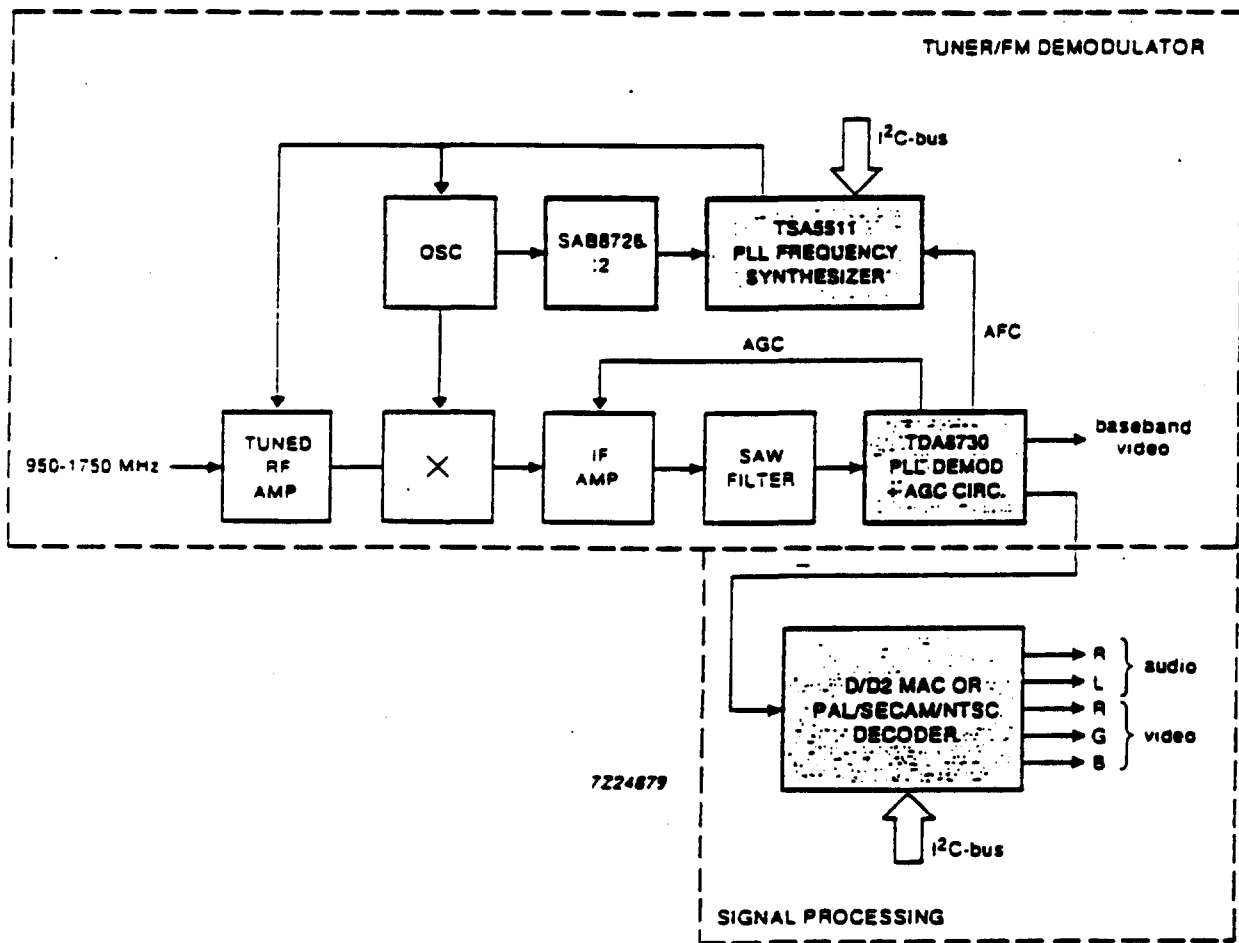


Figure II-5.2 Indoor unit of a satellite TV receiving system.

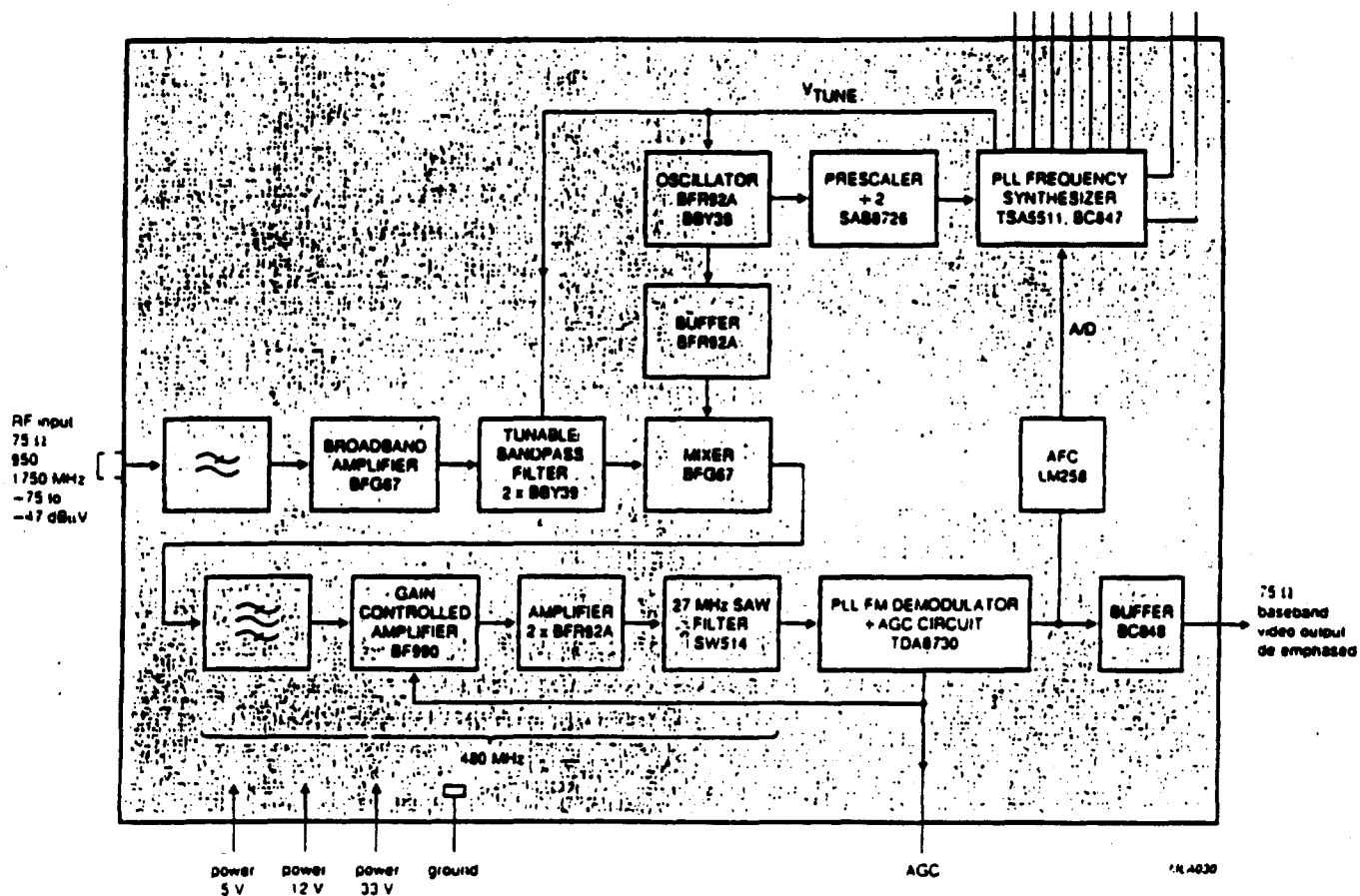


Figure II-5.3 Tuner/FM demodulator.

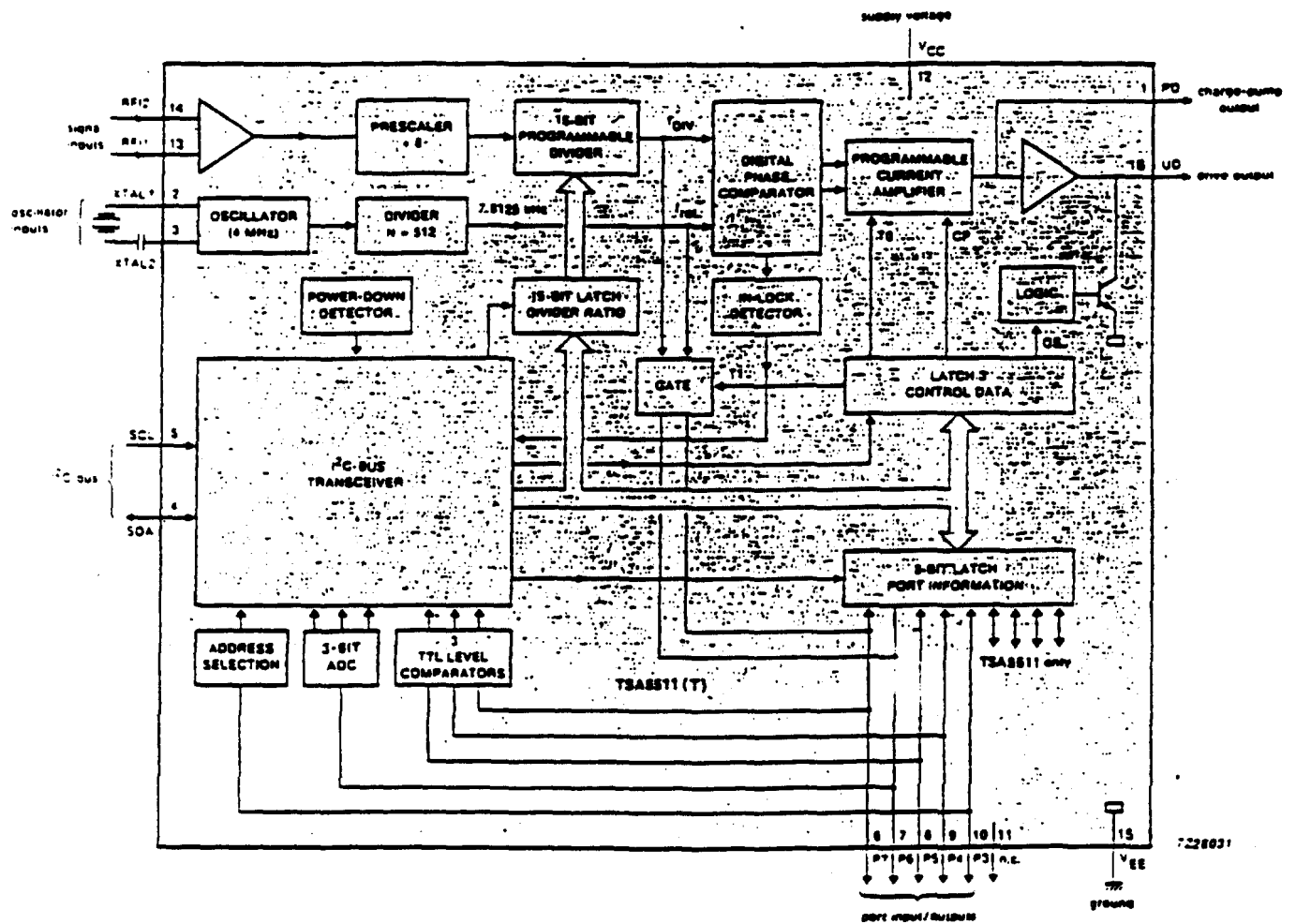


Figure II-5.4 The TSA5511 PLL frequency synthesizer.

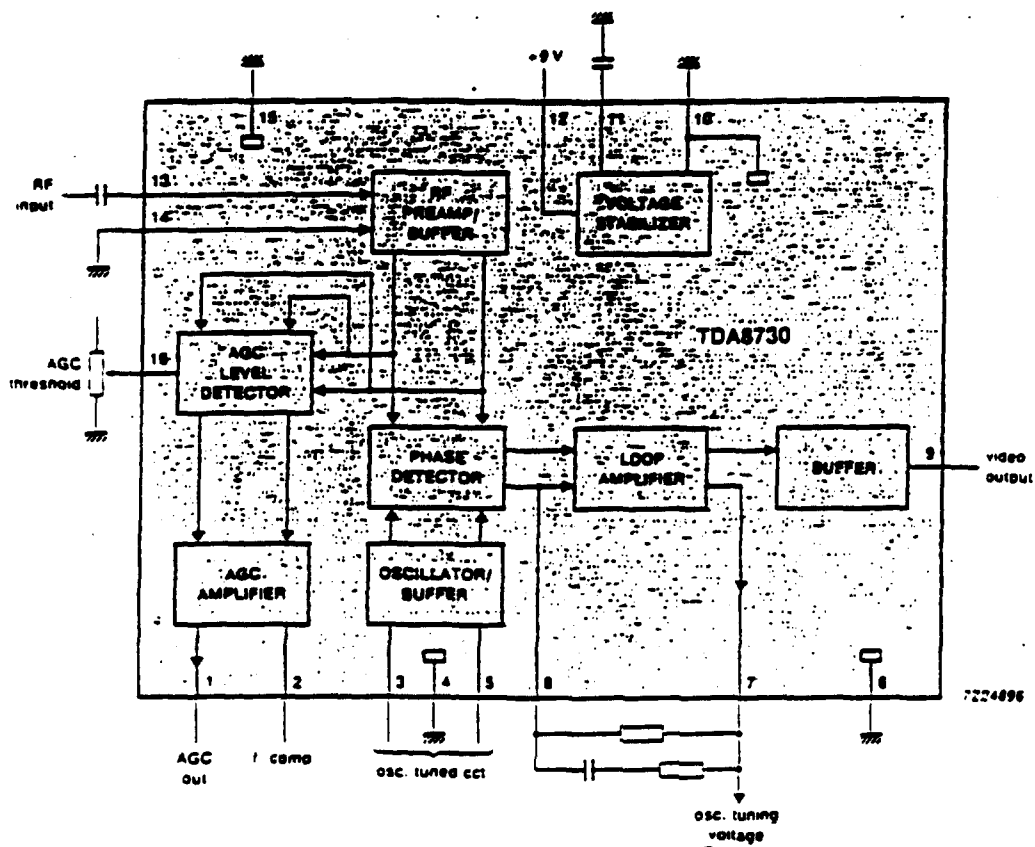


Figure II-5.5 The TDA8730 PLL FM demodulator and AGC.

6. Polarization and Frequency Re-Use

Interference between video distribution signals and two-way communication signals within the same cell and signals in nearby cells is eliminated by the innovative use of frequency diversity, space diversity, antenna polarization, and the FM strong signal capture effect.

The video distribution signals and two-way communication signals are transmitted from each node with orthogonal polarizations. The video signals are contiguously spread across the frequency spectrum with carrier separations of 20 MHz. The two-way communication signals are grouped together into channels which are centered at the edges of the video channels. That is, the center of the two-way communication channels are offset by 10 MHz from the video carriers. The combination of frequency offset and cross-polarization provide 40 dB of effective isolation between video and two-way communication signals at the subscriber's receiving antennas.

The polarization of the signals in adjacent cell node transmitters are reversed. Any subscriber receivers which are located in the fringe area between adjacent cells will be protected from adjacent cell interference because this polarization reversal provides 25 dB of isolation from adjacent cell signals. Additional isolation is provided by the narrow beamwidth subscriber's receiving antenna which is pointed toward its own cells transmitting node. Additional remarks on interference can be found in Appendix 3.

7. Initial System Plan

Based on this study, we can conclude that the cellular system shall be an FM based video distribution. With a 100 W transmitting amplifier, cell diameters of up to 6.0 miles can be supported at New York if FM channels with 20 MHz spacings are used; this assumes that 1 GHz bandwidth will be allocated for

transmission, corresponding to 49 channels with the 20 MHz spacings and frequency offset interleaving of 10 MHz. The transmitting station should be equipped with a (near) omni directional antenna with a minimum 10 dBi gain. This antenna can be realized with a doughnut shaped gain pattern, rather than a hemispherical pattern. The transmitting amplifier backoff of 7 dB is assumed for this service. At the receiver, a 7.5 in. dish antenna with 32 dB gain, and Noise Figure of 6 dB should be employed. No specific recommendation on receiver IF is made, except that 950-2050 MHz appears to be attractive; standard value in European DBS receivers is 950-1750 MHz, which has been extended to 2050 MHz.

It is recommended that scrambling of the video channels be implemented. We estimate that simple, yet reasonably effective methods, can be included in the receiver at a cost of \$30 to \$50. Sophisticated hard to defeat systems can be included at a cost of \$75 to \$100 per receiver.

8. Long Term Options

In the long term, effort should be made to introduce digital video transmission using QPSK modulation whenever costs are reduced to a point where cable and fiber optic systems are in the process of deploying this technology. This will permit a four-fold increase in capacity, for all systems and will allow wireless to remain in competition with hardwired video delivery methods (e.g. coaxial and fiber optic cable). Further, this is the only way HDTV can be delivered to viewers.

The QPSK modulation is one example of digital modulation. Other possible candidates are MSK and GMSK, which have a data transmission efficiency of 1.3 to 1.5 bits/Hz. Unlike QPSK, MSK and GMSK have a constant envelope and hence are attractive for application here.